



**INTERFACING CAMAC SYSTEM
TO MRD-200 RASTER GENERATOR**

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Motivation

The experimenter will wish to visually display beam line information received from an 032 module in addition to writing magnetic tape. User software could simulate beam line 040 pulse train software to display readings from SEMs, loss monitors, etc. Fancier applications might be the calculation of secondary measurements (e. g. , beam transmission and split ratios) or flashing of warning conditions. This paper describes quick and cheap construction of displays (assuming one already has a computer and a CAMAC system).

Simple Memory Buffer

One method is a simple 16-register memory module used in conjunction with the Jorway 72-A Display System (Fig. 1). The memory is written by the computer with $F(16) \cdot A(x)$ and automatically read by the 72-A Display with $F(0) \cdot A(x)$.^{*} (A switch to disable the module's Q response to $F(0)$ is desirable.) Pipeline type memory buffers are incompatible with the 72-A. Even so, 16 pieces of data per CAMAC slot are plenty. The Controls Group 035 24×16 RAM module is ideal for this purpose.

^{*}The reader is assumed to be familiar with CAMAC jargon.

The advantage of this buffer is the simplicity of programming. The 72-A Display (which virtually every Fermilab experiment has) generates the character. The disadvantage is its legibility. The 72-A puts out crate, slot, and subaddress information and no "labelling." The alternative is to drive the MRD-200 directly. The hardware is actually simpler. The software is more involved since the programmer must generate characters and control the raster generator himself.

Direct MRD-200 Driver

Parts:

Below are the components needed and the source:

1. 017 Output Latch (Controls Group)
2. BASIC ADDS MRD-200 (PREP out of Jorway)
3. 72-A/MRD-200 Cable (PREP)
4. Adaptor/Terminator (Homemade).

The choice of hardware options is not optimal, but they are the ones used at Fermilab. Thus, the parts are readily available and interchangeable with units in stock. It is probably a bad idea to have a mixture of MRD-200 types at the Laboratory or to modify output latches which are bound to reenter the equipment pool. Among electronic circuits, a black sheep is not noticeable until he butts you.

The 017 board is a single-width 24-bit output latch. It also supplies a 500 nsec output strobe and can generate a LAM if it is enabled and receives appropriate input (high to low transition). All levels are orthodox CAMAC (TTL HI = 0).

The needed inputs to the BASIC MRD-200 are two control levels (F0, F1), six data levels (B6, B5, B4, B3, B2, B1) and a strobe greater than or equal to 500 nsec. The output used (but not required) is the ready/busy signal. The logic levels of the BASIC MRD-200 are positive true (TTL HI = 1). For the F and B signals this is no problem since one merely loads the 017 module with the complement of the MRD-200 levels desired. The strobe input requirements of the MRD-200 are a low to high transition so the raster generator is sensitive to the following edge of the 017 strobe output. The raster generator has READY = HI and BUSY = LO. Thus, the ready signal must be inverted if an 017 LAM at the end of busy time is desired.

Connections

Figure 2 shows a block diagram. Figure 3 is the required adaptor-terminator. The assignment of 017 bits to the F and B lines is arbitrary but the lowest eight are convenient.

The 72-MRD cable is used for two reasons: one doesn't have to make his own, and mates to the Cannon connector end are available at Fermilab. Figure 4 shows all pin assignments.

Programming

The data input (B6-B1) is "compressed" ASCII code. As far as I can tell this is 7-bit ASCII without the 7'th bit. Alphabets, numerics, and punctuation are uniquely defined. The basic option MRD-200 thus does not recognize control characters (e. g. , form feed) but uses the F0, F1 lines for control. (The ASCII option implements the full 7-bit code.) The PDP-11 assembler directive .ASCII generates the correct bits in the lower 6 of a byte.

Tables of labels are thus easily constructed. Locations corresponding to decimal characters representing variable data are filled with a binary-to-ASCII routine during operation. If a byte to be written into the 017 is actually a display character the 8th and 7th bits are replaced by the appropriate F0 and F1. If, on the other hand, it is a control character the whole byte is replaced. Finally, the byte is complemented and written into the 017 module. The F(16) command latches the output lines and generates the strobe. (If the MRD-200 had the ASCII interpreter option and the complement logic option, all characters are transmitted as is.) Figure 5 is the flow chart. Note that "vertical tab" is used only to home the cursor and not to select a line. Figure 6 is the list of codes. Figure 7 shows the setup of a typical character table.

Deadtime

The MRD-200 takes 1.1 msec to process any transmission except an erase order which is longer. A software loop delay works fine assuming your computer has nothing better to do. A real time clock would work too. The best solution is to have the end of the MRD-200 busy cause a LAM from the 017. Thus the machine could operate like any slow device such as a teletype. However, the levels are incompatible. A LAM would occur at the beginning of the busy period. So the ready/busy levels must be switched.

The transistor inverter in Fig. 3 works well except for one problem connected with the circuit design of the 017. Because the input at 017 pin 15 is normally low when connected to the MRD-200, the LAM is set when the 017 LAM is enabled. This problem is easily circumvented by the software.

Software

Figure 8 shows a flow chart of the routine that actually puts out the display character table. It works, but certainly can be improved.

MRD-200 Options

The ADDS MRD-200 can be obtained with options. Some are blinking, memory protection, and graphics. Another is called an "ASCII Interpreter." The latter itself has an option, namely, normal or complement (= CAMAC) logic.

With the ASCII Interpreter, one replaces the F0, F1 lines by a single B7 line. This is merely the last bit of the full 7-bit code. Now cursor control is done with standard codes such as carriage return, horizontal tab, etc., rather than special F and B bit patterns. The programming would be simpler.

Cursor Control Lines

In addition to the MRD input lines already described, there are five more: cursor up, cursor down, cursor forward, cursor back, cursor home. (The cables supplied by PREP do not have these lines connected.) Since the basic MRD-200 does not have memory protection, use of these lines would save rewriting permanent output every time a change is required to the variable data. But cursor lines are strobes. Though F(17) will cause the output of the 017 latch to strobe rather than establish levels, the normal strobe is still present. This is not allowed by the MRD-200. It hardly seems worth the trouble to implement.

REFERENCES

- 1) How to Use the MRD 200, ADDS, 100 Marcus Blvd. ,
Hauppauge, NY, 11787
- 2) How to Maintain the MRD 200
- 3) Schematics and Component Layouts MRD 200
- 4) Module 016/017 24 Bit Output, Schematic Number 0810. 215-ED-34027

LIST OF FIGURES

- 1) Visual Display with Memory Buffer and Jorway 72-A
- 2) Visual Display with Output Latch and ADDS MRD-200
- 3) 017 to MRD Adaptor/Terminator
- 4) Connections
- 5) ASCII to MRD Code Conversion Routine
- 6) List of Basic MRD-200 Codes
- 7) Example of Display Table Setup
- 8) Display Character Buffer Output Routine



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FIGURE 1

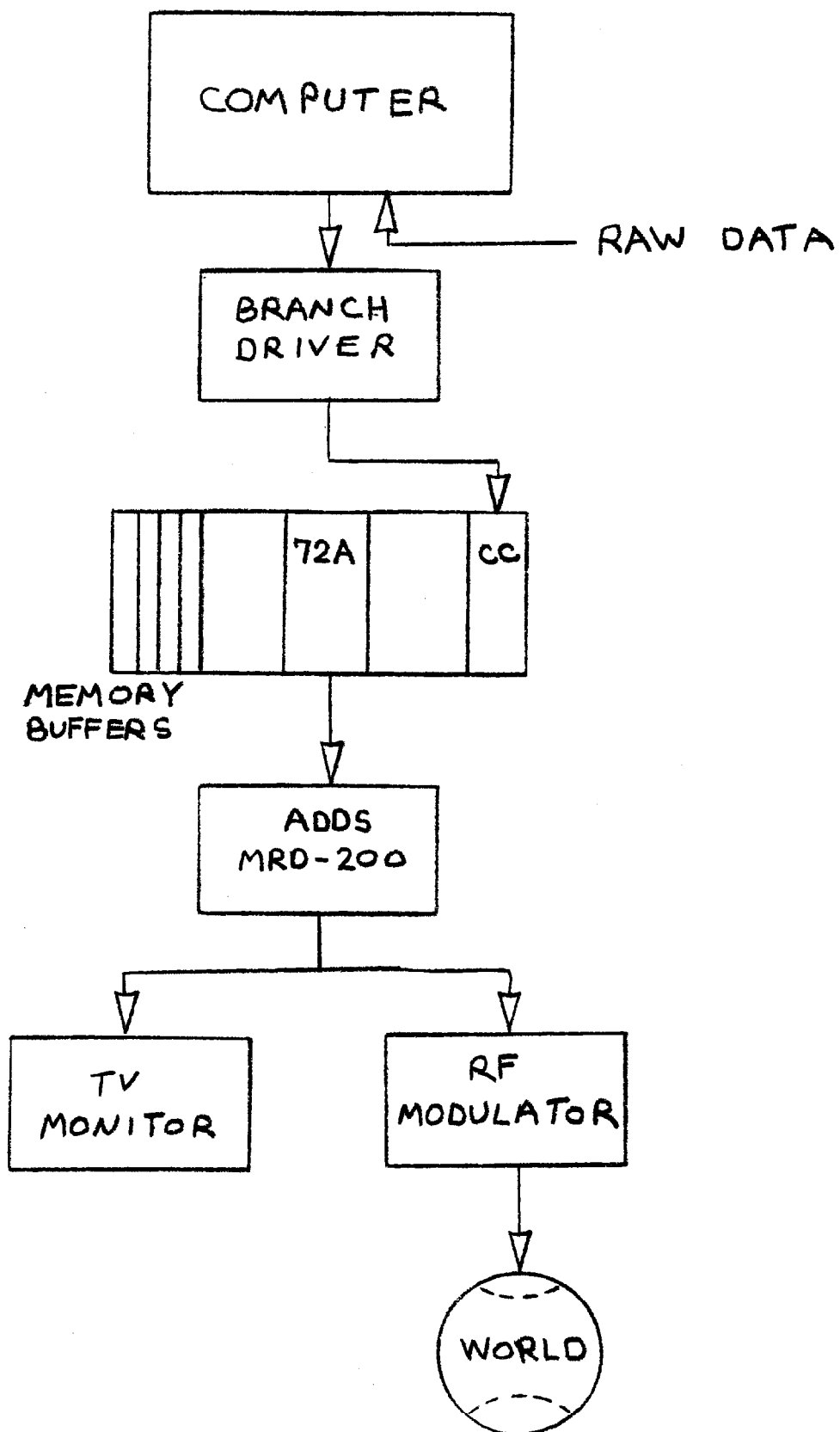
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VISUAL DISPLAY WITH MEMORY AND 72-A





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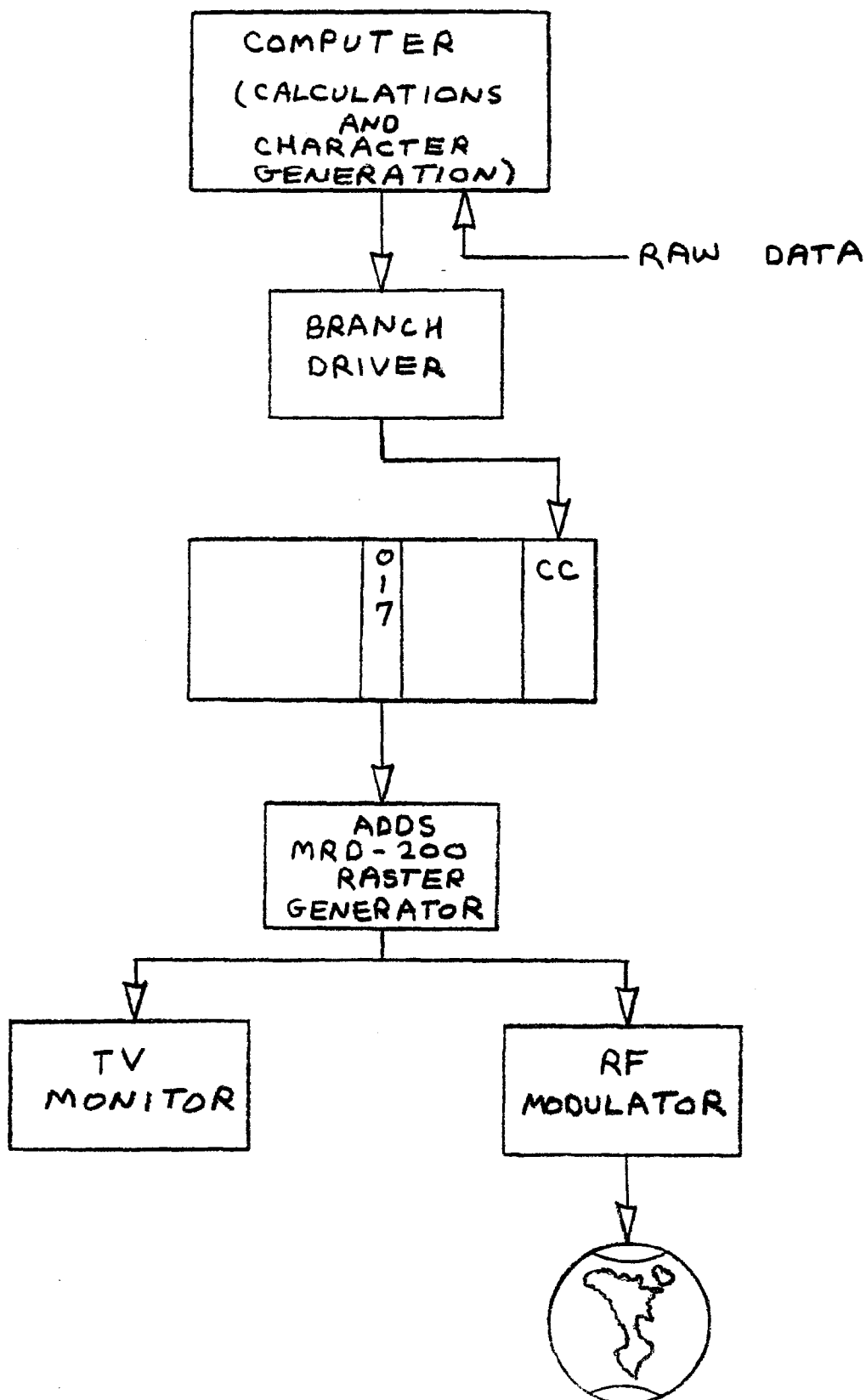
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FIGURE 2

VISUAL DISPLAY WITH OUTPUT LATCH AND MRD-200





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FIGURE 3

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017 to MRD ADAPTOR? TERMINATOR

VIKING
2 x 18
EDGE CONNECTOR
(017)

CANNON
52 PIN CONNECTOR
ON 72A/MRD
CABLE

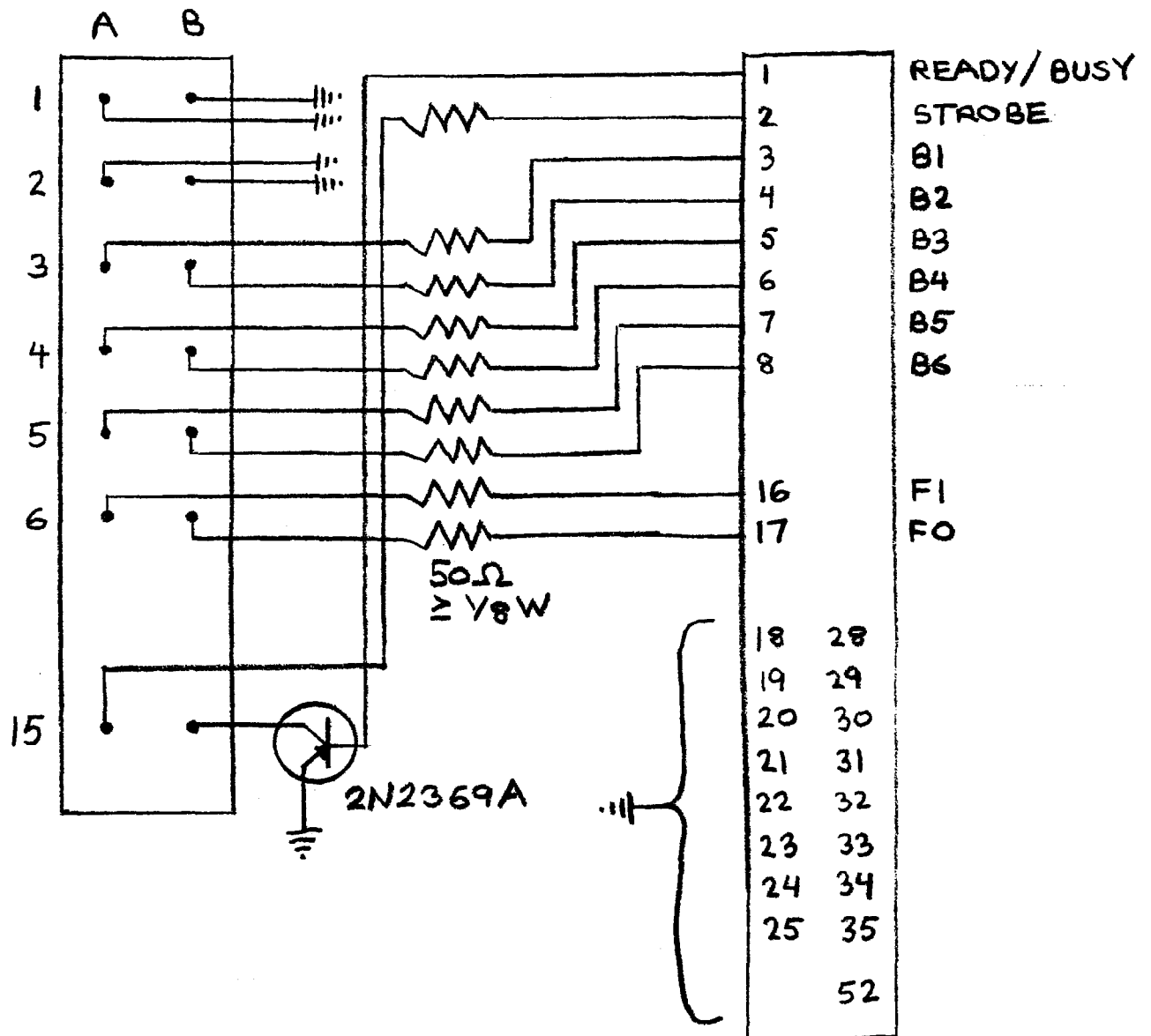


FIGURE 4

CONNECTIONS

<u>017</u> <u>Schematic</u>	<u>017</u> <u>Connector</u>	<u>Cannon</u> <u>Connector</u>	<u>MRD</u> <u>Connector</u>	<u>Signal</u>
15	15B	1	J1-1	Ready/Busy
15R	15A	2	J1-2	Strobe
3R	3A	3	J1-8	B1 (in)
3	3B	4	J1-9	B2 (in)
4R	4A	5	J1-10	B3 (in)
4	4B	6	J1-11	B4 (in)
5R	5A	7	J1-12	B5 (in)
5	5B	8	J1-13	B6 (in)
6R	6A	16	J2-10	F1
6	6B	17	J2-11	F0
1R	1A	18	J1-14	Returns and Grounds
1	1B	19	J1-15	
2R	2A	20	J1-20	
2	2B	21	J1-21	
		22	J1-22	
		23	J1-22	
		24	J1-23	
		25	J1-23	
		28	J2-16	
		29	J2-17	
		30	J2-18	
		31	J2-19	
		32	J2-20	
		33	J2-21	
		34	J2-23	
		35	J2-24	
		52	J2-25	



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FIGURE 5

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ASCII to BASIC MRD CODE CONVERSION ROUTINE

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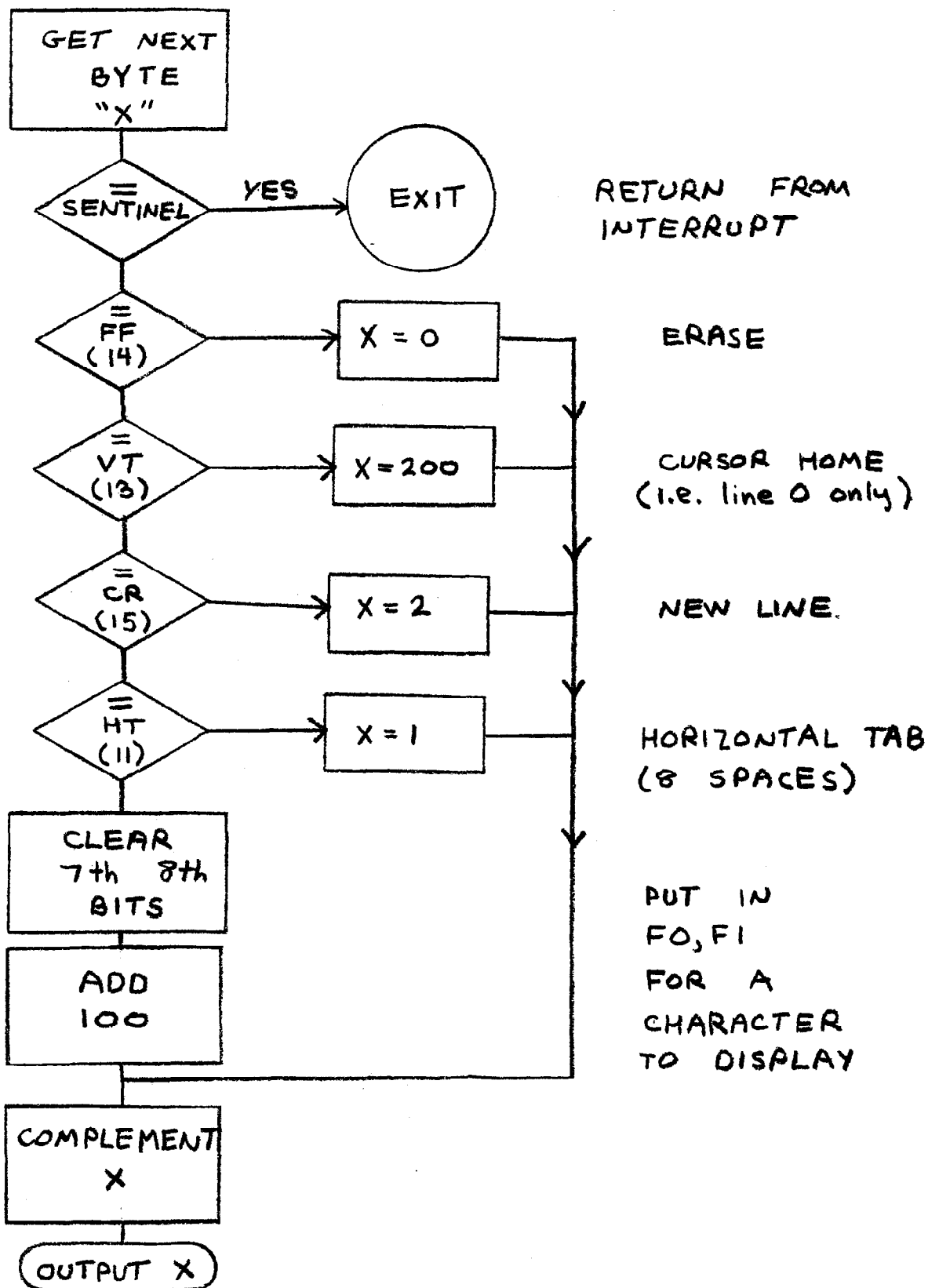


FIGURE 6

Function Codes for Basic MRD-200 (from Ref. 1)

NOTE: USE OF "CR" OR "HT" CAUSE ERASURE OF REMAINDER OF LINE OR TAB

	Control Input		Tag Bit*	Data Input					
	F ₀	F ₁		I ₆	I ₅	I ₄	I ₃	I ₂	I ₁
Write Data	0	1	0	D	D	D	D	D	D
Line Select	1	0	X	X	D	D	D	D	D
Screen Erase	0	0	X	X	X	X	X	0	0
New Line	0	0	X	X	X	X	X	1	0
Horizontal Tab	0	0	X	X	X	X	X	0	1
Write Data Tagged*	0	1	1	D	D	D	D	D	D

VT
FF
CR
HT

	Control Input		Tag Bit*	Data Output					
	F ₀	F ₁		O ₅	O ₄	O ₃	O ₂	O ₁	O ₀
Read Data*	1	1	D	D	D	D	D	D	D

* Optional

NOTE: "D" inputs are interpreted as displayable characters or used to define a line address, depending on the operating mode.

"X" inputs are ignored by the MRD-200 and may be either "0" or "1"

FIGURE 7

EXAMPLE OF DISPLAY TABLE SETUP

```
MRDTAB:      ASCII  <14>/DE(I)  /<11>/      /
              ASCII  <15>/DATE   /<11>/      /
              ASCII  <15>/TIME   /<11>/      /
              ASCII  <15>/SE309H/<11>/      /
              ASCII  <15>/L310   /<11>/      /
              ASCII  <15>/L320   /<11>/      /
              ASCII  <15>/SE500L/<11>/      /
              ASCII  <15>/QH600  /<11>/      /
              ASCII  <15>/LLAM   /<11>/      /
              ASCII  <15>/SE500H/<11>/      /
              ASCII  <15>/L400   /<11>/      /
              ASCII  <15>/LSE309/<11>/      /
              ASCII  <15>/SE600  /<11>/      /
              ASCII  <15>/LSEP   /<11>/      /
              ASCII  <15>/L322   /<11>/      /
              ASCII  <15>/L500   /<11>/      /
*
              ↑
              SPACES RESERVED
              FOR VARIABLE
              DATA
```

THE ABOVE PRODUCES A
SIMPLE LABELLED LIST



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FIGURE 8

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DISPLAY CHARACTER BUFFER OUTPUT ROUTINE

CALL MRD (ADDRESS)

MRD 017 LAM HANDLER

